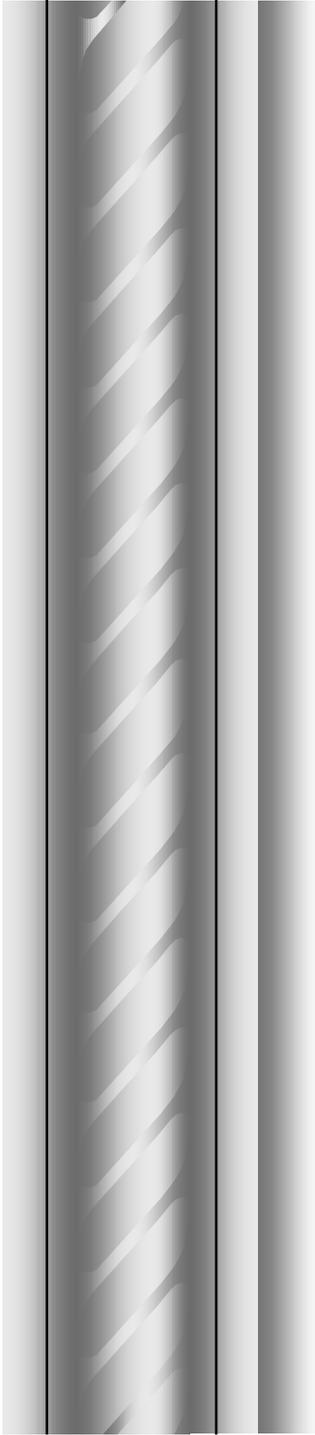


NCSX Coil Design Overview

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Coil Design Does **Not** Occur in a Vacuum

- **Physics design impacts coils**
 - ι/N , N , ι' (shear)
 - surface reconstruction: realize physics
- **Engineering impacts coils**
 - plasma-coil separation, PBX geometry
 - current density/forces (support structures), bends, feeds
 - tolerance for field errors: coil “realizability”
 - N-scan of I (accessibility, coil size)

Coil Design: Methodology

● **Current Sheet Solutions**

- **NESCOIL + Dipole Code (Valanju, Pomphrey)**
- **SVD (smoothing) algorithm**

● **Filament Extraction**

- **Current contouring algorithms (Brooks)**
- **ONSET code (Brooks, Drevlak, Valanju)**

Methodology (cont'd)

- **Reconstruction (Reiersen)**
 - VMEC (finite beta, current)
 - AVAC (vacuum, islands)
- **Resonance Error Reduction**
 - NESCOIL implementation (Miner, Merkel, Valanju)
 - ONSET (Drevlak)
- **Feedback on Physics**
 - Complexity measures (Hirshman, Boozer)

Progress

- **Dipole (real space NESCOIL) method + SVD looks promising**
 - Current contouring -> coils
- **Coordinate-free resonance formulation**
 - May improve reconstructability
- **Saddles + helicals**
 - Reconstruction at $\beta=0$ improved
 - Understand poor reconstructions

Progress (cont'd)

- Robustness of fixed-coil geometry
(vary beta, b-norm error maintained)
- Vacuum transform scans (startup scenarios)
 - iota enhancement through additional shaping (Zarnsdorff)
- Coupling of NESCOIL+VMEC
 - poised to feedback on physics design through complexity measure

Areas Requiring Attention

- **Resonance error mitigation**

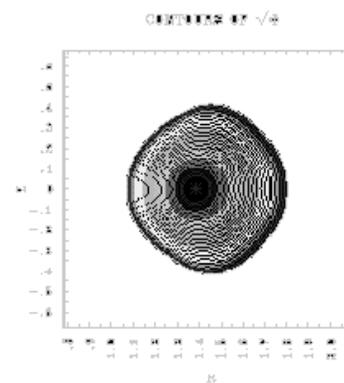
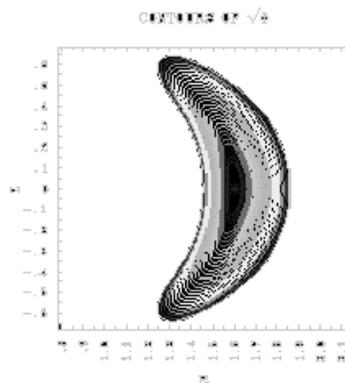
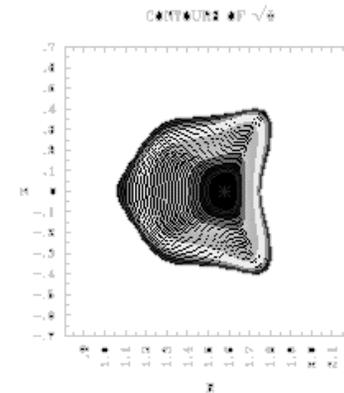
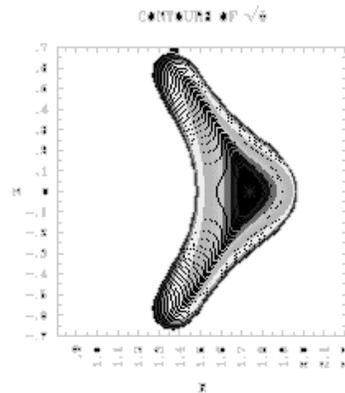
- evidence that res. error worse for discrete saddles than modulars
- lower ι/N favored (larger m)
- important: poor reconstruction \Rightarrow poor replication of physics goals

- **PIES**

- needed to look at finite beta, current reconstruction problems

D9E Reconstruction

- N=2, beta = 5%, tokamak iota (40% ext)



Vacuum

$I = 0$

Attention Required (cont'd)

- **Scenarios**

- VF: centering;
- QF: shaping, iota control as startup

- **Finite sized coils**

- Field error
- Impact on iota

- **Continue code enhancements**

- NESCOIL
- coil extraction